



HP-85 I/O ROM and HP-IB Interface



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The HP-85 Desktop Computer, I/O ROM (Read-Only Memory, part no. 00085-15003) and 82937A HP-IB interface form an I/O control system suited to a wide variety of applications. The HP-85 is a complete computer system, including the central processor and all necessary peripherals in a package weighing only 18 pounds, ideal for the laboratory or the production line. Simply plug the ROM drawer, with the I/O ROM, and the HP-IB interface card into two of the four slots in the back of the machine, and the desktop computer is transformed into an I/O controller.

HP-IB (Hewlett-Packard Interface Bus)

For more than ten years, Hewlett-Packard has been designing instruments and controllers to be compatible with the IEEE-488 interface standard. The HP-IB, Hewlett-Packard's implementation of IEEE-488, spawned a whole generation of instruments designed for systems. The HP-IB interface allows you to spend your time *using* sophisticated measurement systems, not connecting and testing them.

Hewlett-Packard now offers 119 HP-IB instruments and peripherals, with more being added each year. Furthermore, the IEEE-488 standard, or GPIB, has become an international standard. Hundreds of instruments from many manufacturers are now compatible with the standard.

The HP-IB is an easy-to-use hardware and software interface that permits bidirectional, asynchronous communication among a wide variety of instruments. Up to 14 instruments that have built-in HP-IB capability can be interconnected via a simple one-bus system. The interface uses 16 lines to carry all data and control information in byte-serial fashion. A unique three-wire handshake technique allows data transfer over eight signal lines at a speed determined by the specific device being addressed. (If not addressed, slower devices will not hamper communication speed.) General interface management is handled over the remaining five signal lines.

Each device connected to the bus can be designated either a TALKER (sends data), a LISTENER (receives data), or both. An HP-IB system usually has a device, such as a desktop computer, that is used as a CONTROLLER (manages bus communications). Each device is assigned a unique address that allows the controller to communicate with the various devices in an extremely flexible manner. These communications include data transfer, status checking, remote and local control, and many other control functions.

*Data subject to change.



The HP-85 as a Powerful Controller

The HP-85 includes 16 384 bytes of read/write memory (14.6K available to the user), expandable with a plug-in module to 32 768 bytes (30.7K user-available). It is programmed in BASIC, one of the most widely used and "friendly" computer languages. Automatic syntax checking of all program lines simplifies programming, as do the versatile editing features. A computer "self-test" key will initiate a functional test of the CPU and all its internal peripherals.

A CRT display provides 16 lines of 32 alphanumeric characters each, plus full graphics capability. Mass storage of programs and data is handled by the standard DC100 tape cartridge, offering 200K bytes of on-line storage. The quiet, built-in, thermal printer will print 32-character lines at two lines per second. A printed copy of the graphics display is produced with a single keystroke.

In I/O applications, several other standard features increase flexibility. Four user-definable keys, expandable to eight with the SHIFT key, enable program branch selection for repetitive tests or untrained operators. The system includes three separate programmable timers, capable of interrupting a running program at periodic intervals for instrument sampling or data analysis.

I/O ROM Capabilities

The BASIC language is enriched with straightforward I/O commands through the 00085-15003 I/O ROM. Any I/O system requires program statements or subprograms, commonly called "I/O drivers", to pass data and commands among instruments. Often these are complex, and are

usually different for each device. With the HP-85 I/O ROM, these language enhancements are already provided, so the programmer needs to use only a few standard BASIC commands. Statements are provided to configure, control, pass data to and from, and check the status of devices in the I/O system. The I/O ROM plugs into one of six spaces in the ROM drawer, which in turn fits in one of the four slots in the back of the computer.

The I/O ROM provides basic input and output capabilities including formatted, free-field and binary ENTERs and OUTPUTs, with or without character conversions. String variables may be defined as I/O buffers, offering extremely flexible interaction with slow and fast devices sharing the HP-IB. Data may be entered and output through the buffer in either interrupt or fast handshake mode. Additional capabilities include programmable keyboard lockout, bit manipulation, number-base conversion, device timeout and I/O error detection.

Specifications

ROM memory — adds 8192 bytes of read only memory to the operating system.

R/W memory — uses 416 bytes of read/write memory out of the available user memory.

Speeds — fast handshake up to 25K bytes/second (maximum data rate — actual rates depend on the program, I/O card and peripheral used).

General Statements

The I/O ROM adds a set of general capabilities to the HP-85 that do not deal directly with interfacing. These capabilities provide for bit manipulation, base conversion, keyboard masking and error determination.

BINAND — returns the logical AND of two 16-bit values.

BINCMP — returns the binary complement of a 16-bit value

BINEOR — returns the logical EXCLUSIVE OR of two 16-bit values

BINIOR — returns the logical INCLUSIVE OR of two 16-bit values

BIT — tests the specified bit and returns a true (1) / false (0) indication

BTD — returns the decimal value of a binary string

DTB\$ — returns a string with a binary representation of a decimal number

DTH\$ — returns a string with a hexadecimal representation of a decimal number

DTO\$ — returns a string with an octal representation of a decimal number

ENABLE KBD — allows masking of keyboard to prevent unintentional keystrokes

ERRSC — returns the select code of the last card that caused an error

ERROM — returns the ROM number of the last option ROM that caused an error (I/O is # 192)

HTD — returns the decimal value of a hexadecimal string

OTD — returns the decimal value of an octal string

Universal I/O Statements

The I/O ROM adds a set of interfacing statements to the HP-85 whose meaning is common to all interfaces. These capabilities provide for data transfers, data conversions, interface control, interrupts, and end-of-line branching.

CONTROL — allows access to I/O card control registers or to write buffer status registers

CONVERT — sets up input or output conversion tables for ENTER or OUTPUT on a specified select code or an I/O buffer. The conversion can be an indexed table or a pairs lookup table.

ENABLE INTR — sets up an I/O card to interrupt on a specified condition

ENTER — allows for formatted or free-field entry of data from an I/O card or an I/O buffer

IOBUFFER — turns a string variable into an I/O buffer

OFF EOT — turns off the **end of transfer** end-of-line branch

OFF INTR — turns off the ENABLE INTR end-of-line branch

OFF TIMEOUT — turns off the SET TIMEOUT end-of-line branch

ON EOT — on **end of transfer**, specifies where in the BASIC program to go for service

ON INTR — when an ENABLE INTR condition occurs, specifies where in the BASIC program to go for service

ON TIMEOUT — when a handshake timeout occurs, specifies where in the BASIC program to go for service

OUTPUT — allows for formatted or free-field output of data to an I/O card or to an I/O buffer

RESET — causes a hardware reset of the I/O card

SET TIMEOUT — sets up for handshakes to an I/O card to timeout and specifies the length of time in milliseconds to wait until timing out

STATUS — allows access to I/O card status registers or to read I/O buffer status registers

TRANSFER — allows for interrupt or fast handshake data transfers between an I/O buffer and an I/O card

HP-IB Statements

The I/O ROM adds statements to the HP-85 that access capabilities determined by the interface card being used. The following describes how the HP-IB interface card interprets these statements.

- ABORTIO — sends InterFace Clear if system controller, else sends My Talk Address if active controller, else stops handshaking data
- ASSERT — allows access to bus management lines
- CLEAR — sends Selective Device Clear or Device Clear
- HALT — stops an interrupt type TRANSFER
- LOCAL — sends Go To Local or Remote disable
- LOCAL LOCKOUT — sends Local LockOut message
- PASS CONTROL — passes active control
- PPOLL — returns the value of a parallel poll
- REMOTE — Remote Enable
- REQUEST — allows the programmer to set Service Request line and the serial poll response byte
- RESUME — drops the attention line (ATN)
- SEND — allows sending of arbitrary data / command sequences over HP-IB
- SPOLL — returns the value of a serial poll conducted on an HP-IB device
- TRIGGER — sends Group Execute Trigger message

82937A HP-IB

The HP 82937A interface implements the IEEE 488-1978 Standard Digital Interface for Programmable Instrumentation. It may communicate to as many as 14 HP-IB compatible instruments per interface. The HP 82937A uses an interface processor to provide efficient management of the interface bus protocol. The HP 82937A interface can achieve data transfer rates up to 25K bytes/second (absolute maximum).

Data Input/Output

Eight bidirectional data lines provide data input/output.

Control Lines

DAV	} provide handshake
NRFD	
NDAC	

Interface Management

IFC	} provide control of the interface system
ATN	
SRQ	
REN	
EOI	

Interface Functions

The chart below specifies level of implementation in terms of IEEE 488-1978 mnemonics. The Device Trigger, Device Clear, and Service Request state responses are achieved by programming the HP-85 for end-of-line interrupts on those conditions.

Source Handshake	SH1 (full)
Acceptor Handshake	AH1 (full)
Talker	T6 (part)
Listener	L4 (part)
Service Request	SR1 (full)
Remote/Local	RL1 (full)
Parallel Poll	PP2 (part)
Device Clear	DC1 (full)
Device Trigger	DT1 (full)
Controller	
System control	C1 (full)
IFC & Take charge	C2 (full)
REN	C3 (full)
Respond SRQ	C4 (full)
Miscellaneous control	C5 (full)
Extended talker	TE0 (note 1)
Extended listener	LE0 (note 1)

Note 1: The HP-85 HP-IB card allows for interrupts on secondary commands. This allows a user to program the HP-85 to respond to TE4 and LE2 extended talker and listener.

Interrupt Capability

When used with the I/O ROM, the 82937A is capable of responding to any or all of the following interrupt conditions:

- active controller
- active talker
- active listener
- service request (SRQ)
- interface clear (IFC)
- device clear (DCL, SDC)
- device trigger (GET)
- secondary command (SCG)

Switch Configuration

The following switch configurations are accessible by opening the interface card. No switches are accessible without opening the card.

Select Code — allows one of 8 possible select codes to be set for the interface card. The select code range is 3 through 10 (1 is internal CRT, 2 is internal printer). Default select code setting for the 82937A card is 7.

Interface Bus Address – 5-bit talker/listener address. The default bus address for the 82937A is 21 (decimal).

System Controller – allows the 82937A to act as a system controller or non-system controller. The default setting is with the 82937A configured as system controller.

Jumper Configuration

The 82937A can be configured by a jumper wire to respond to a parallel poll. The designated bit is then asserted in response to a parallel poll when the interface is asserting SRQ. The card is configured with a parallel poll response on bit 0 of the data lines.

Ordering Information

Item	Part No.
ROM drawer	82936A
I/O ROM and Manuals	00085-15003
HP-IB Card	82937A
Additional HP-IB Cables	
0.5 m (1.6 ft)	10833D
1 m (3.3 ft)	10833A
2 m (6.6 ft)	10833B
4 m (13.1 ft)	10833C
metric adapter	5060-0138

The 82937A is shipped with a 2 m (6.6 ft) interface cable terminated with the standard HP-IB connector and metric fasteners. The HP-IB card and the additional cables use HP's new shielded connector. There are 13 HP-IB instruments that will not accept the new connector. In those cases, the 10834A adapter is used.

For assistance call the HP regional office nearest you: Eastern 301/258-2000, Midwest 312/255-9800, Southern 404/955-1500, Western 213/877-1282, Canadian 416/678-9430. Or write to Hewlett-Packard, 3404 East Harmony Road, Fort Collins, Colorado 80525; in Europe, Hewlett-Packard GmbH, Desktop Computer Division, Herrenberger Strasse 110, D-703 Boeblingen, Postfach 1430, West Germany; elsewhere in the world, Hewlett-Packard Intercontinental, 3495 Deer Creek Road, Palo Alto, California 94304.

